	INVENTION DISCLOSURE (WKRP Document No. 20010104.063046)		Add PD Number	View Disclosure History	Send Back to Inventors	Done Viewing Document
	PD Number: 10011307		Date Received by Legal: 01/28/2001		Managing Attorney: CGR	
	Invention Disclosure status: Submitted 0% Complete					
General Information Invention History Description of Invention Inventor Information Witness Information Additional Information Administrative Record						

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General Information Section Complete
Title: Write a descriptive title of the invention. manufacturing process for direct tunneling emitter
Abstract: Write a brief abstract of the invention. A improved manufacture process was developed in this invention for direct tunneling electron emitter device. Comparing first generation process, this invention provides much better pad to pad isolation, resolved top to bottom electrode shorting issue, and improves device yield from ~ 5 % to 40 %. The pad to pad isolation is improved by using metal etch to replace trench oxide etch. The top to bottom electrode shorting is resolved by redesign the process flow and using thin dielectric lift-off process. The device yield is improved by adding an annealing process at end. With optimizing annealing condition, the device yield is improved significantly.
Projects: Select projects associated with disclosed invention. Orca
Products: Select product names or numbers associated with this invention. MIS flat emitter

Invention History Section Complete
Published: Was a description of the invention published, or are you planning to publish? If so, when and in what publications? No
Announced: Was a product including the invention announced, offered for sale, sold, or is such activity proposed? If so, when and where? No
Disclosed: Was the invention disclosed to anyone outside of HP, or will such disclosure occur? If so, when and to whom? No
Urgency: Will the invention be published, announced, or disclosed in the next 3 months? No
Described: Was the invention described in a lab book or other record? Yes In electron files and lab note book
Built: Was the invention built, modeled, or tested? If so, when? Yes November 11, 2000
Government Contract: Was the invention made under a government contract? If so, the agency and contract number:

1307a

No

Description of Invention

Section Complete

Prior Solutions: List prior solutions and their disadvantages.

In the first generation direct tunneling process, there were following issues:

1. oxide trench etch process was used for isolation, but it did not provide good isolation between emitters, and pad to pad, because of good step coverage of metal deposition. It results in poor isolation (~ 10 ohm was measured between pad to pad).
2. The thin emission layer was deposited before first layer metal etch. Therefore, extremely high selectivity is required for the metal etch process. Due to very thin emission layer (50 - 100 Å) is needed for direct tunneling device, the requirement is very difficult to meet. And top to bottom electrode shorting is a big issue.
3. there was no annealing in the process. Therefore, interface is not well conditioned between first and second layer metal, as well as the interface between emission layer and N++ silicon.

Problems Solved: Explain the problems solved by the invention.

In this invention, isolation between emitters is improved from 10 Ohm in prior solution to greater than 30 MOhm in this invention. Top to bottom shorting issue is resolved by redesign the process flow and using dielectric lift off process. This change in process flow removes the high selectivity requirement for metal etch process. The device yield is improved from ~5 % to 40% by implementing and optimizing an annealing process.

Advantages: What are the advantages of the invention over what has been done before?

The improved manufacturing process in this invention provides much better isolation between emitters, resolved top to bottom electrode shorting, and resulted in high device yield.

Description: Describe the construction and operation of the invention.

A improved manufacture process was developed in this invention for direct tunneling electron emitter device. Comparing first generation process, this invention provides much better pad to pad isolation by using second layer metal etch to replace oxide trench etch. And it resolved top to bottom electrode shorting issue by redesign process flow (emission thin film is deposited after first layer metal etch, and apply dielectric lift off process. Finally, improved device yield from ~ 5 % to 40 %, by adding an annealing process at end. With optimizing annealing condition, the device yield is improved significantly.

Inventor Information

Section Complete

Inventor(s): Pursuant to my (our) employment agreement, I (we) submit this disclosure:

Chen, Zhizhang (John) [00306262]
Corvallis, OR, USA

Telnet: 715-1143
Location Code: 6410-5335

john_chen2@ex.cv.hp.com
Added by Chen, Zhizhang (John) on 1/5/01

Johnstone, Mark A [00305459]
Corvallis, OR, USA

Telnet: 715-0195
Location Code: 6410-3702

Mark_Johnstone@ex.cv.hp.com
Added by Chen, Zhizhang (John) on 1/5/01

Ramamoorthi, Sriram [00305761]
Corvallis, OR, USA

Telnet: 715-1142
Location Code: 6410-5335

sriram_ramamoorthi@ex.cv.hp.com
Added by Chen, Zhizhang (John) on 1/5/01

Regan, Michael [00306086]
Corvallis, OR, USA

Telnet: 715-0588
Location Code: 6410-5350

mike_regan@ex.cv.hp.com
Added by Chen, Zhizhang (John) on 1/5/01

Inventor Home Addresses: Enter the home address of each inventor. This information is legally required to process your invention disclosure.

Inventors	Home Street Address	City	State/ Province	Zip/ Postal Code	Country
Chen, Zhizhang (John)	4411 Snowbrush Dr.	Corvallis	OR	97330	United States [US]
Johnstone, Mark A	33949 Bond Rd	Lebanon	OR	97355	United States [US]
Ramamoorthi, Sriram	5062 SW Technology Loop, Apt 91	Corvallis	OR	97333	United States [US]
Regan, Michael	3210 NW Arrowood	Corvallis	OR	97330	United States [US]

Inventor Citizenships: Select the country of citizenship for each inventor.

Inventors	Country of Citizenship
Chen, Zhizhang (John)	United States [US]
Johnstone, Mark A	United States [US]
Ramamoorthi, Sriram	India [IN]
Regan, Michael	United States [US]

Inventor Mail Stops: Enter the HP Mail Stop for each inventor.

Inventors	HP Mail Stop
Chen, Zhizhang (John)	MS113A
Johnstone, Mark A	MS113
Ramamoorthi, Sriram	MS113A
Regan, Michael	MS10318

Non-HP Inventors: Please list the names, home addresses, telephone numbers, email addresses, and countries of citizenship of inventors who are not affiliated with HP.

Witness Information		
Section Complete		
Witnesses: This invention has been explained to and understood by the following witnesses.		
Liao, Hang [00306348] Corvallis, OR, USA	Telnet: 715-8074 Location Code: 6410-5335	hung_liao@ex.cv.hp.com Added by Chen, Zhizhang (John) on 1/5/01
Witness Dates: At what date was this invention first explained to and understood by each witness?		
Witnesses	Date Understood	
Liao, Hang	January 3, 2001	

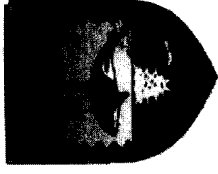
Additional Information			
Section Complete			
Electronic Documents: Do you have electronic document files to upload?			
File Name Click to View MIS1.ppt	Size Bytes 119296	Uploaded Date 1/5/01	Uploaded By User Chen, Zhizhang (John)
Paper Documents: Do you have paper documents to include with your Invention Disclosure that you would like to send by FAX?			
Categories: Select WKRP categories where this invention disclosure should be indexed.			
Manufacturing Technologies: Fabrication			
Keyword(s): Select keywords to index this invention disclosure.			
MIS direct tunneling emitter			
Invention Workshop: Was this Invention Disclosure prepared as a result of an Invention Workshop? If you are not sure, select No.			
Yes			

Administrative Record <small>7 Required Fields Remaining</small>
Legal Admin: Select the name of the Legal Admin(s) working on this Invention Disclosure:
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Legal Entity and Site: Select a Legal Entity and Site where this Invention Disclosure will be handled and reviewed:

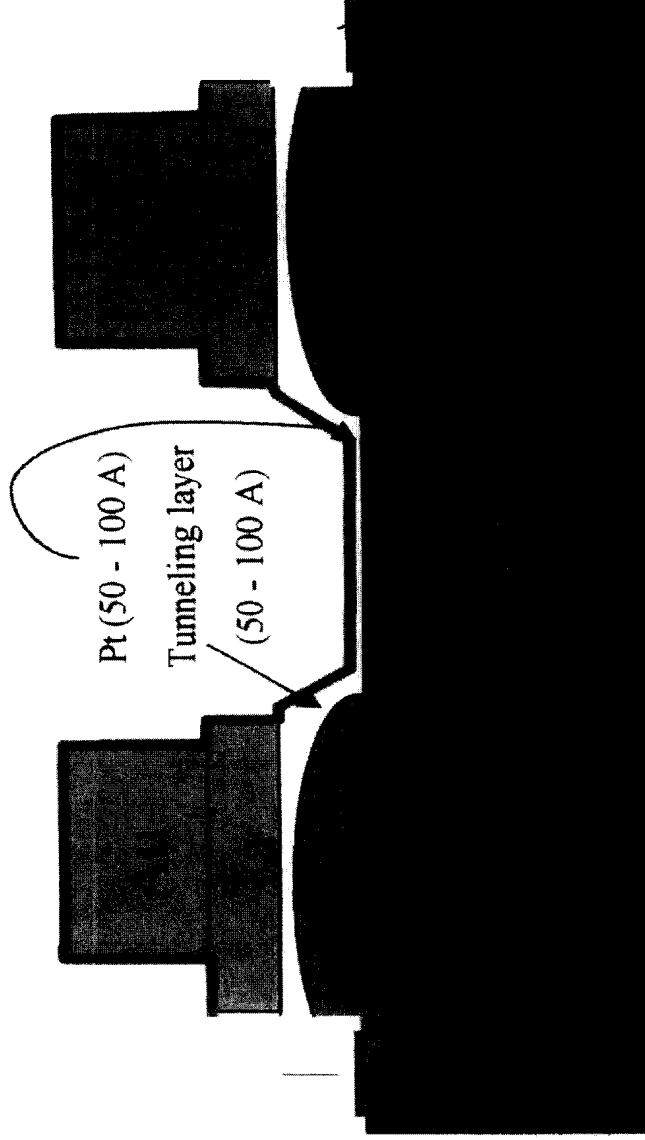
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Direct Tunneling MIS emitter process

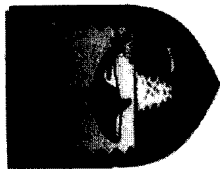


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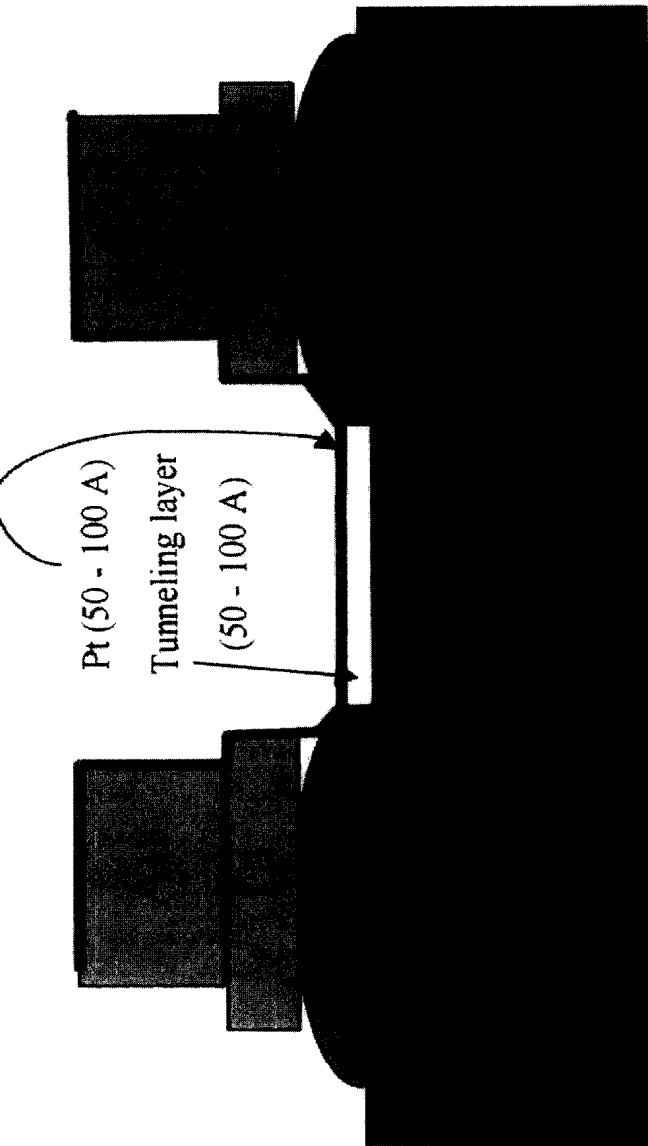


First generation process

1. define emission area by FOX
2. emission layer deposition
3. Ta/Au deposition
4. Metal 1 photo patterning
5. Au wet etch
- 6 Ta dry etch
7. trench photo
8. oxide trench etch
9. Top thin metal deposition



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Improved process

1. define emission area by FOX
2. Ta/Au Deposition
3. Metal 1 photo patterning
4. Au wet etch
- 5 Ta dry etch
6. Tunneling layer dep./lift off
7. Top thin metal dep.
8. trench photo
9. thin metal etch (or lift-off)
10. anneal